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2004

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RISK COPING STRATEGIES AND CONSUMPTION INSURANCE IN CASH CROP AGRICULTURE: THE CASE OF INDIAN PEPPER GROWERS

Wouter Zant

ABSTRACT

We identify and assess the importance of risk coping strategies of Indian pepper growers, typical cash crop producers. Among growers with tiny holdings, income earned outside agriculture is identified as a coping mechanism. Little evidence is found for diversification into alternative crops, storage of harvested commodities and selling livestock as coping mechanisms. Financial savings are most likely important. Variation of crop revenue, total income and consumption expenditure is quantified and their difference is evaluated. Consumption smoothing by income smoothing occurs among growers with tiny and medium sized holdings but is of moderate size. Finally, the degree of consumption insurance is investigated. The estimations suggest significant but moderate divergence from complete insurance for growers with medium sized holdings. Covariant and idiosyncratic components of risks are quantified.

JEL CODE: Q12

KEY WORDS: revenue uncertainty, risk coping, consumption smoothing, consumption insurance, farm households, India

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Introduction

Both prices and output of cash crops tend to fluctuate heavily. Does the resulting variation in revenue also affect expenditure on consumption? In order to investigate this the major strategies to cope with risks are described and, to the extent that the data allow this, empirically identified. We attempt to assess the importance of these strategies for smoothing consumption. Next, we measure variation in cash crop revenue and compare it with the variation in total income and in consumption expenditure. We proceed with estimating the degree of consumption insurance. The lack of consumption insurance is defined by the degree to which the growth rate of household consumption co-varies with the growth rate of total household income. The main objective of this paper is to add to the empirical evidence in the current literature on consumption smoothing and consumption insurance, using data from typical cash crop smallholders.

The paper is organised as follows. In Section 1 we present a concise overview of the literature on risk coping strategies, consumption smoothing and consumption insurance. In Section 2 we explain the source and design of our survey data and we present descriptive tables and figures characterising the position of Indian pepper growers. In this section we also attempt to identify how this consumption smoothing comes about. In this connection we consider income diversification, cutting back consumption expenditures, storage of commodities, sales of livestock, financial savings and access to credit. In Section 3 we quantify observed variation in crop revenue, total income and consumption expenditure. Variation in consumption expenditure is shown to be small and income smoothing is shown to achieve this to a certain extent. In Section 5 we present derive a formal test to investigate the degree of insurance of households against shocks. We provide econometric evidence of the relationship between consumption expenditure and total income for all growers, and by size of holding. We test the extent to which farmers are insured against shocks. Section 6 gives the concluding remarks of this exercise.

1. Risk coping, consumption smoothing and consumption insurance: a snapshot of the empirical literature

There are excellent surveys on risk coping, consumption smoothing and consumption insurance (see amongst others Fafchamps (1999)). We do not pretend to improve this

work, but intend to limit ourselves to presenting a concise summary of the literature that is relevant for the purpose of our investigation.

There are a range of strategies to cope with risks. Many of these are well documented in the empirical literature. A standard taxonomy of behavioural responses to risk distinguishes ex-ante or preventive measures, measures undertaken to reduce the risk exposures by changing the set of potential outcomes before the shocks actually occur, and ex post strategies, strategies designed to mitigate or absorb the adverse impacts of shocks on welfare. Within the latter group we may further identify self insurance, and insurance arrangements with others, either formally or informally.

With regard to preventive measures, in general, production and employment decisions are made in the light of expected income and expected risk. Risk averse households will tend to exchange activities with high expected returns and high risks for activities with low returns and low risks (Morduch (1995)). Farmers reduce risk by growing their own food (Fafchamps (1992)) and by adjusting their crop choices (Fafchamps and Kurosaki (2002)). Risk aversion will also make farmers reluctant to do large investment in new technologies or use expensive inputs, since it is highly uncertain whether adoption of new technologies or use of expensive inputs will offer the expected returns (Feder (1980), Bliss and Stern (1982)). Agricultural households are shown to adopt production techniques that avoid exposure to risk (Rozenzweig and Binswanger (1993)). A standard technique to spread risk, widely practised and in many instances of the preventive type, referred to as diversification[1]. Diversification takes on a wide range of appearances such as cultivation of alternative crops and combining on-farm and off-farm employment.

Ex-post behavioural reactions and coping strategies take one a variety of appearances. A first and indeed common reaction to income shocks is to cut back consumption. Some evidence indicates that non-food consumption expenditures act as a means of partially insuring ex-post the consumption of food from income shocks (Skoufias and Quisumbing (2003)). Likewise cutting back consumption expenditure may be associated with sending children to work instead of school to supplement income and to economize of school fees (Jacoby and Skoufias (1997)).

[1] Diversification also could entail shifts from low value added to high value added production. Recent promotion of fruit and vegetable crops as substitutes for traditional cash crops fall under this heading. From a farmers' perspective the incentives to diversify in these crops is income enhancement and much

Depletion of accumulated non financial assets, either in the form of sales of cattle, sales of durable consumption goods or sales of stored of commodities, is another technique applied in some countries and documented for a number of situations. Empirical evidence on this type of behavioural reaction is not unanimous (Fafchamps et al.(1996), Burger, Gunning, Kinsey(1998), Deaton (1992).

Households may protect themselves against risks by participating in informal insurance networks with friends, relatives, neighbours and others (Rozenzweig (1988), Besley (1999), Morduch (1999)). Informal insurance in the form of social safety networks is ex ante fairly difficult to identify empirically. The extent of informal insurance reveals itself only if shocks actually occur.

In some circumstances use of formal saving instruments is possible (Paxson (1992)) or using loans from agricultural banks (Udry (1994)), though in many developing countries savings institutions are non-existent or underdeveloped and credit to the agricultural sector is highly uncommon, due to lack of collateral, large monitoring costs and high non repayment records.

Another, relatively new, type of formal insurance specifically aims at insuring price and production risk of a specific crop. The practical implementation of the recently developed index insurance is still in its infancy, but it appears to be a potentially interesting and promising insurance instrument. It is particularly attractive since it avoids the problems of traditional (formal) crop insurance, namely moral hazard, adverse selection and high administrative costs (Skees et al. (1999, 2001, 2002)). If available for a sufficiently large number of crops it allows efficient allocation of resources in liberalised economies.

2. Survey data, description of pepper cultivation and risk coping strategies

In order to assess the extent of consumption smoothing we make use of survey data. In particular we exploit data from a representative survey among south Indian pepper growers, undertaken at the end of the 1990s and the start of 2000.[2]. The core data used in this paper cover two complete crop years (1998-99 and 1999-2000).

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less risk spreading. Hence, not all diversification is risk reducing and preventive in character.

[2] The survey data have been collected and compiled by the Spices Board of India, Cochin and the Economic and Social Institute of the Free University, Amsterdam. Financial support from the Indo

During this period households in the sample were interviewed on a monthly basis. Additionally recall data are available for another three crop years (1995-96, 1996-97 and 1997-98). The monthly surveys are supplemented with a number of annual surveys in order to cover a range of subjects which show little variation on a monthly basis. The sample contains data on 250 pepper growers. The sample is taken from a larger representative sample of 2500 farmers (for a discussion of the design of this survey, see Cheriankunju et al. (1999)) and the 250 observations have been distributed among blocks (the lowest stratum identified in our estimation) proportionate to the number of pepper vines in each block.

Pepper is a perennial crop: the pepper vine winds along a support tree, bears fruit after 3-5 years and reaches an average age of 20-25 years. The crop is grown under a wide range of conditions in terms of plant variety, support tree, altitude, soil, mode of cultivation (mono, mixed, homestead), scale of production, crop combinations, rainfall, sunshine, humidity, use of inputs, etc. The larger proportion of the area under pepper in the south of India pertains to mixed cropping cultivation (Kerala close to 90%, Karnataka, 77% and Tamil Nadu close to 100%). The major crop combinations under pepper growers in Kerala is the combination of pepper, coconut and arecanut or plantain, and in Karnataka and the district of Wayanad in Kerala, that of pepper, coffee and arecanut or cardamom. The crop season starts in April. In the south of India the monsoon sets in June and extends to August. Depending on the area, harvesting takes place from December to March. In the season 1998-1999 and 1999-2000 Kerala accounted for around 60-75% of total Indian production, and within Kerala the bulk of this pepper production (around 40-60%) originates from the higher districts of Idukki and Wayanad[3].

Dutch Program on Alternative Developments (IDPAD) is kindly acknowledged.

[3] Reliable figures of production of pepper are hard to obtain. The quoted figures are own calculations reported in Cheriankunju et al. 1999a,b, where the measurement of production of Indian pepper is specifically addressed.

Figure 1 Distribution of holding sizes of pepper growers

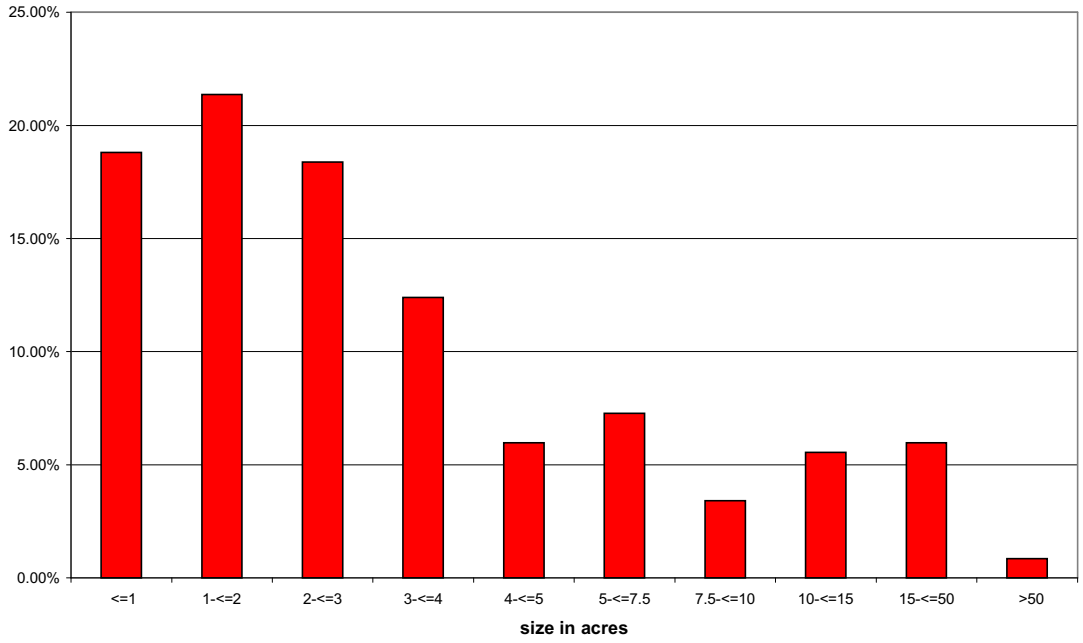
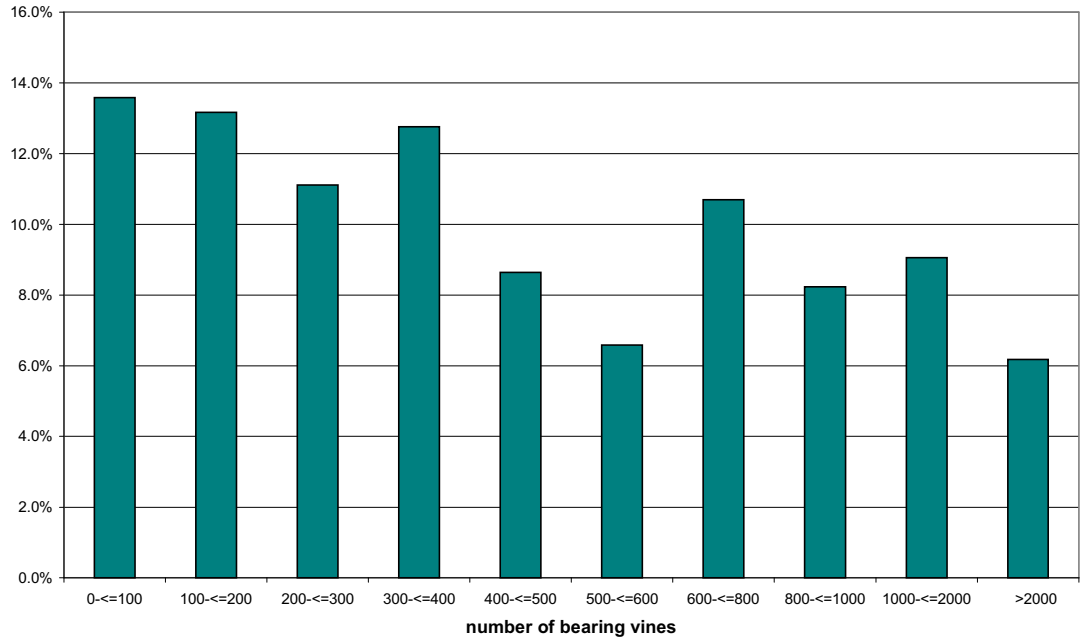


Figure 2 Distribution of number of bearing vines per growers



The prevalence of a variety of cropping systems (mixed cropping, mono cropping, homestead cultivation), but also cultivation at a variety of densities, make it virtually impossible to determine the area share of each crop. Data on total holding size are, however, available. With a weighted average (median) total holding size of

4.7 (2.4) acres[4], holdings of pepper growers are small. The distribution of holdings by size (see Figure 1) indicates that close to 60% of Indian pepper growers have holdings sizes of less than 3 acres. An indicator of the relative importance of pepper cultivation is the number of stands or bearing vines. Using this measure avoids use of the conceptually problematic character of area under pepper. The figures above showing the distribution of pepper growers by total holding size and by the number of bearing vines (see also the table in the appendix combining these two) confirm that the larger part of growers has small holdings and the greatest number of growers derive a significant share of their agricultural income from pepper.

3. How is consumption smoothing achieved?

3.1. Diversification of income sources

A standard way to achieve smoothing is through income diversification: most farmers have a number of sources of income apart from revenues from their main crop and if the risks of the different income components are not covariant, or, even better, if these risks are negatively correlated, diversification stabilises income and hence consumption. In our empirical work we identify three major sources of income: revenue from pepper, revenue from other crops and income generated outside agriculture i.e. outside the farming activities on the own holding. The major revenues from other crops, for the pepper growers in our sample, consists of revenue from natural rubber, coffee, cashewnut and paddy. The source of non agricultural income consists of employment outside the own holding, property income, remittances and a residual category[5]. To get an impression of the role of various income sources, we have graphed the share of a specific income component in total income by holding sizes (see Figure 3a to c).

[4] One acre equals 0.4047 hectare or, equivalently, 1 hectare ≈ 2.5 acres.

[5] On average, conditional on a non-zero value of this variable, this residual category turns out to be close to 70% of all non agricultural income.

Figure 3a Share of revenue from pepper in total income (micro evidence)

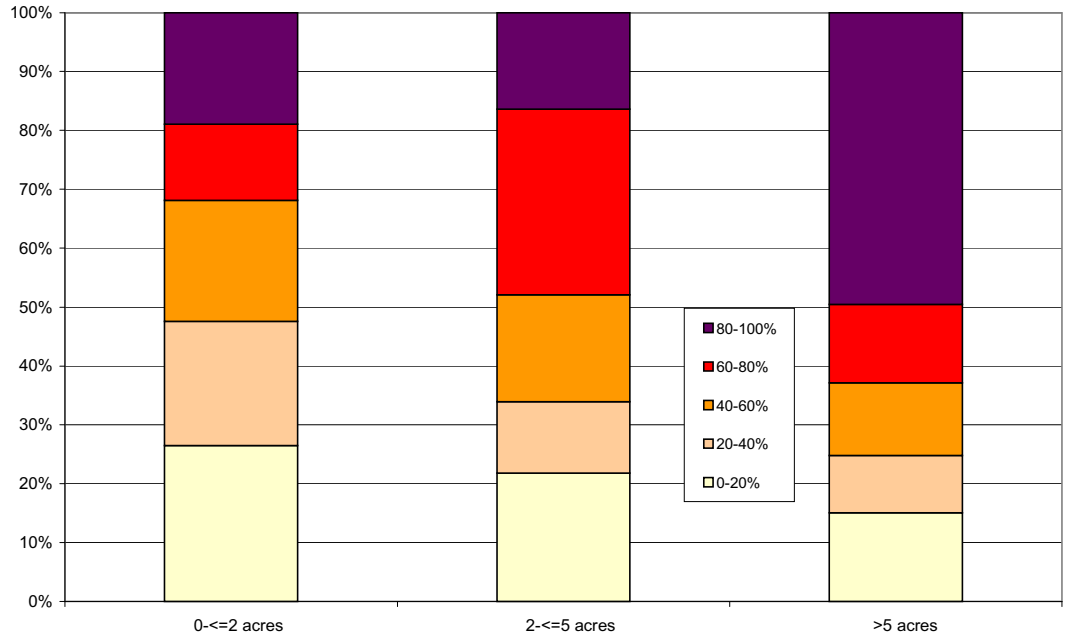


Figure 3b Share of revenue from other crops in total income (micro evidence)

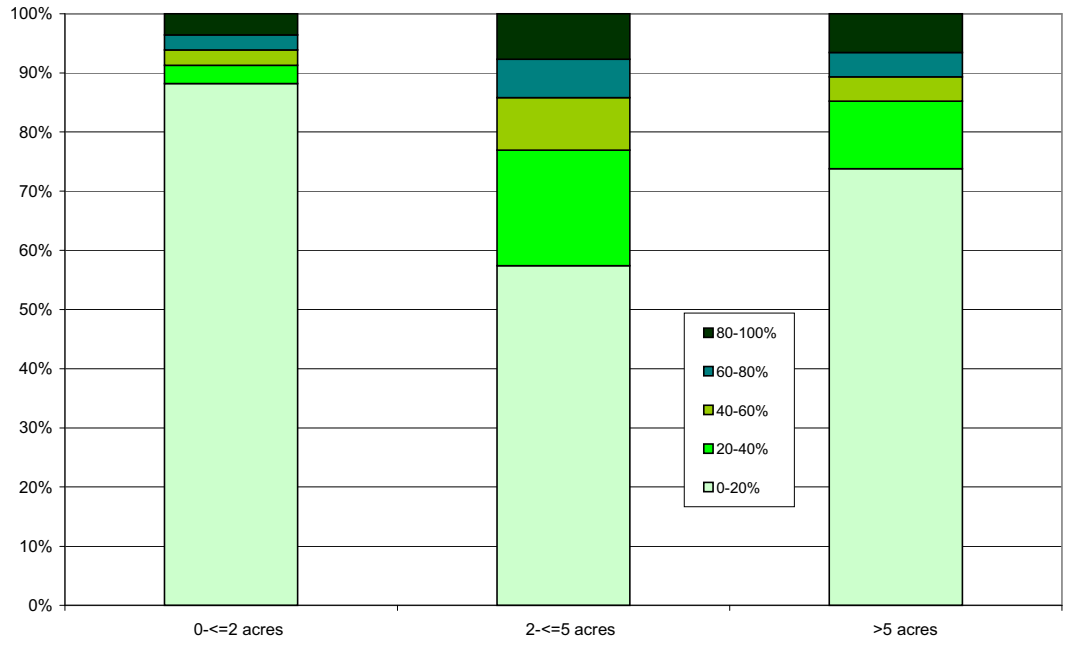
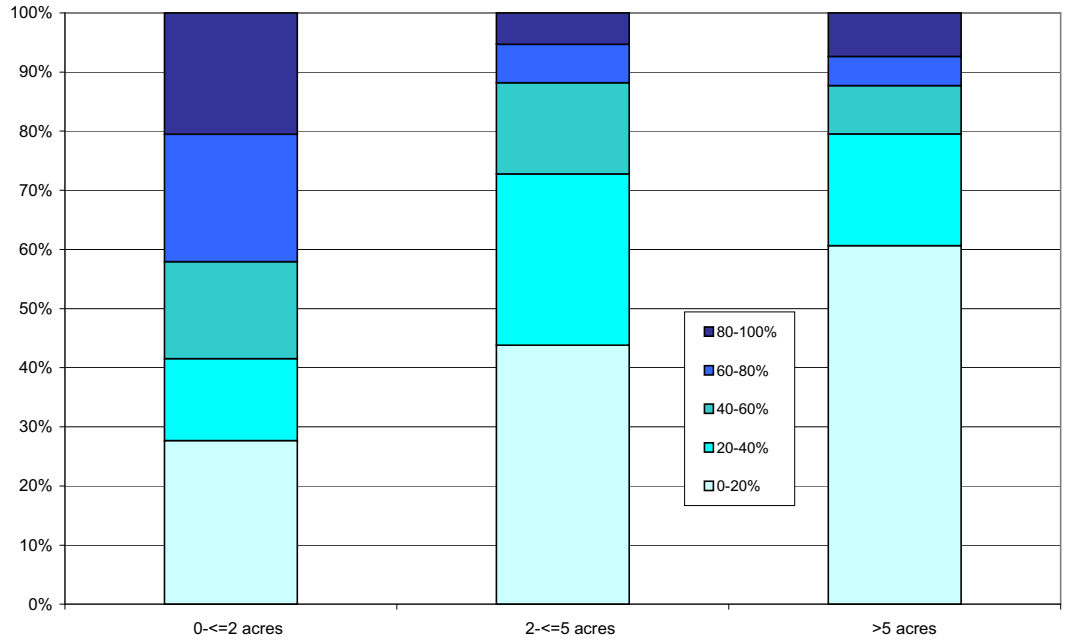


Figure 3c Share of non agricultural income in total income (micro evidence)



From Figures 3 a, b, and c we derive that:

- Income from outside agriculture is a major source of income for farmers with small holdings (less than 2 acres): more than 60% of this group earns a share of 60% or more of their total income from sources outside agriculture. For these pepper growers other crop revenues also constitute a minor contribution to total income. These observations corresponds with other research (see e.g. Reardon (1997), Fafchamps and Lund (2003) and Fafchamps and Quisumbing (1998)).
- In terms of its contribution to total income, revenue from other crops is significant for pepper growers with medium sized holdings (2 to 5 acres) but it is of little quantitative importance to farmers with holding sizes of less than 2 acres or larger than 5 acres;
- To a large extent only large pepper growers (with a holding size larger than 5 acres) have revenues of pepper as their most important source of income (>60%). Apparently specialisation is only possible once a certain scale of production is realised.

In short, our sample includes a group of typically large specialized farmers, a group of mainly small farmers who are less dependent on pepper, and a group of middle sized farmers who are intermediate. To what extent income diversification out of

agriculture has contributed to more stable total income and total consumption expenditure is not evident from these figures and will be investigated below.

3.2 Reducing per capita consumption

One way to react on negative income shock and income shortages is to reduce consumption expenditure. Cutting back on consumption expenditure avoids households being forced to sell productive assets. Reducing consumption expenditure rather then liquidating productive assets allows households to maintain their capacity to earn income in the future. A number of authors clearly find support for the importance of this type of behaviour (see e.g. Fafchamps, Udry and Czukas (1996)).

Agricultural households will have an incentive to cutback on consumption if desired consumption expenditure is either income constrained or near to being income constrained. To investigate this hypothesis empirically we have estimated average per capita consumption for households with and without an income constraint. The income constraint is identified by comparing total consumption expenditure with total income: if consumption expenditure equals or exceeds total income the household is considered as having been income constrained.

A kernel density estimation of the frequency distribution of total per capita real consumption for income constrained and unconstrained households, shown in Figure 4, suggests that cutting back of consumption hardly occurs. At the very least, it is difficult to identify visually. We further investigate if the same conclusion holds once we distinguish households by size of holding. From Table 1, showing the results of a simple t test on consumption expenditure by holding size[6], the following picture emerges. Positive values - indicating cutting back of consumption - are observed for growers with small sized holdings but these are nowhere statistically significant. Significantly higher values of consumption expenditure are more often observed for income constrained households, suggesting the reverse of cutting back consumption: higher per capita consumption levels have contributed to becoming income constrained.

[6] We simply test if the difference between average per capita real consumption of constrained and unconstrained households differs significantly from zero. We do this for the two crop years separately (1998-1999 and 1999-2000) and for the crop year 1999-2000 using the income constraint of the previous year, 1998-1999. cutting back consumption is identified with average unconstrained consumption expenditure to be higher than average constrained consumption expenditure (hence, positive values of the test variable in the table; all consumption expenditure variables real and per capita)

Figure 4 Per capita total consumption expenditure

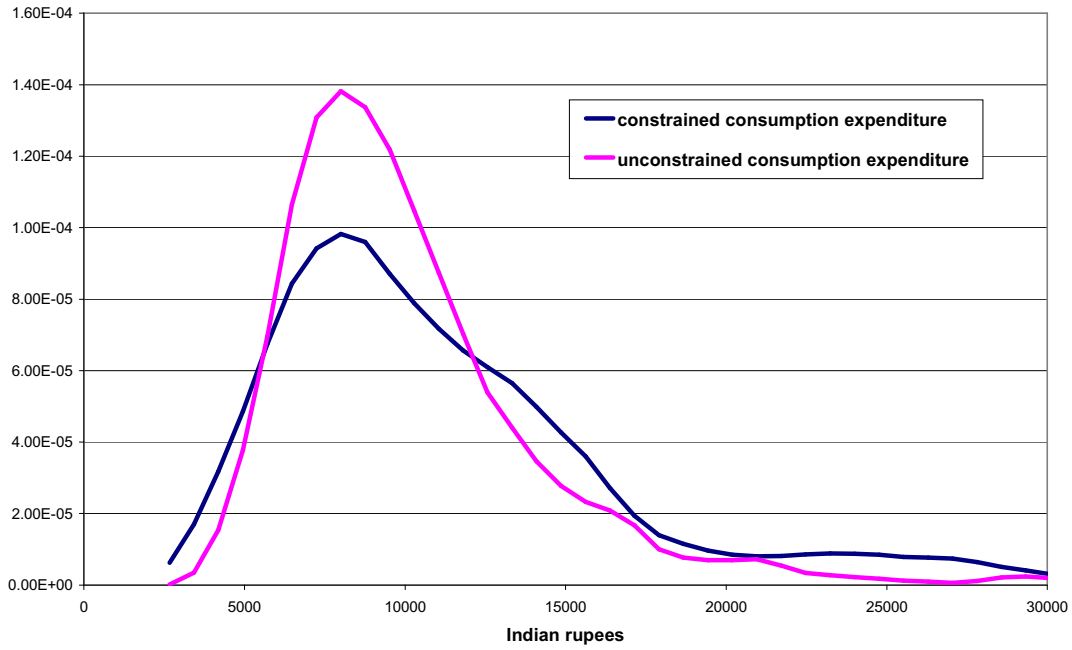


Table 1

Testing cutting back consumption*

	cropyear 1998-1999			**cropyear 1999-2000**			**Cropyear 1999-2000**		
		constraint: current year			constraint: current year			constraint: previous year	
Size of holding	Total	food	non-f	Total	Food	non-f	total	food	non-f
0 – 2									
Average	-0.1	0.0	-0.1	1.1	0.7	0.3	1.6	0.7	0.9
	(0.0)	(0.0)	(0.1)	(0.6)	(0.7)	(0.6)	(0.9)	(0.6)	(1.3)
Median	-0.7	-0.1	-0.7	0.8	0.5	0.4	1.2	0.3	0.9
	(0.6)	(0.1)	(1.0)	(0.9)	(0.9)	(0.7)	(0.8)	(0.4)	(1.4)
2 – 5									
Average	-2.3	-1.0	-1.3	-1.8	-0.8	-0.9	-1.8	-1.2	-0.5
	(3.1)	(3.1)	(2.7)	(2.4)	(1.9)	(2.6)	(2.2)	(2.7)	(1.4)
Median	-2.4	-1.0	-1.6	-0.6	0.2	-0.7	-0.4	-0.7	-0.1
	(3.3)	(4.3)	(3.2)	(1.3)	(0.5)	(2.2)	(0.8)	(1.5)	(0.2)
> 5									
Average	-34.8	-7.4	-27.9	-24.8	-6.9	-18.7	-29.1	-7.2	-22.7
	(2.7)	(2.5)	(2.6)	(1.7)	(2.1)	(1.6)	(2.1)	(2.3)	(2.1)
Median	-11.3	-6.4	-5.2	-5.3	-3.6	-2.3	-7.3	-4.4	-2.5
	(1.0)	(2.3)	(0.7)	(1.4)	(3.1)	(1.3)	(0.7)	(2.8)	(0.3)

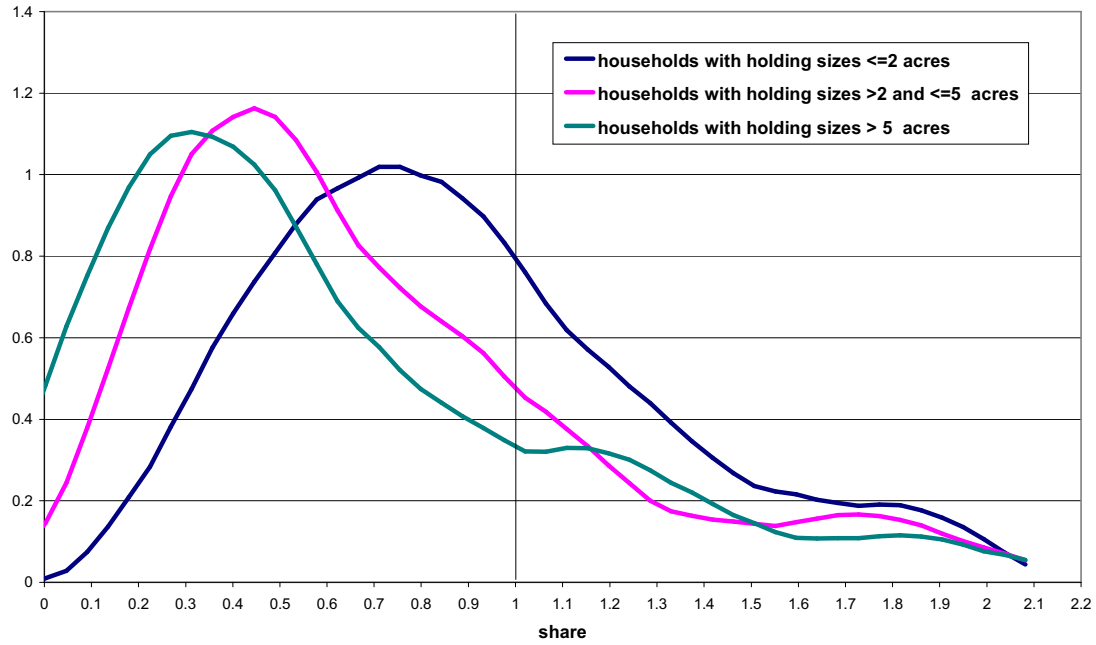
* test: mean($c_{i,unconstrained}$)-mean($c_{j,constrained}$)= 0 where the constraint is identified if total income is below total consumption expenditure in the current year (first 6 columns) or the previous year (last 3 columns); Bootstrapped absolute t-values in brackets below the test variable.

3.3 Saving

Consumption smoothing may be achieved to a certain degree by depleting accumulated saving. Saving has a variety of appearances. Saving may be achieved by putting revenues from crop cultivation or other income on a saving account at a bank or by keeping savings in money form in a safe at home. Where access to (saving) banks is unavailable or unattractive, saving may also be achieved by accumulating non financial assets such as stocks of harvested agricultural production, livestock, durable consumer goods (transport and housing equipment) or by investing in human capital (education of children) or physical capital (land, replanting or new planting, equipment).

Total annual income, calculated as the sum of annual revenues from pepper, other annual crop revenues and other annual income from non-agricultural sources, may be compared with total annual consumption expenditure. This reveals the extent to which households are in a position to save, and the extent to which they are short of income to cover current consumption expenditure. In Figure 5 a kernel density estimation of the frequency distribution of annual consumption expenditure relative to total annual income is shown, distinguishing households by total holding size.

Figure 5 Consumption expenditure expressed as a share of total income



The larger part of all farmers – both with small, medium and large holdings - have current consumption expenditure that is well below their current total income. Hence, a considerable proportion of growers in our sample appears to be in a position to save. Unfortunately, we lack data on saving accounts and possible investment outlays and, consequently, it is not possible to present further details on saving, accumulated savings and saving behaviour of Indian pepper growers. Two additional observations can be made on the basis of Figure 5. First, the figure also suggests that a significant number of growers - both with smaller, medium and larger holdings - cannot cover their consumption expenditure with total income. Around 38% of all pepper growers have consumption expenditure that exceeds total income. It is unclear how this consumption expenditure is covered. Secondly, and as expected, farmers with small holdings spend, on average, a much larger fraction of their total income on consumption, than farmers with medium and large holdings.

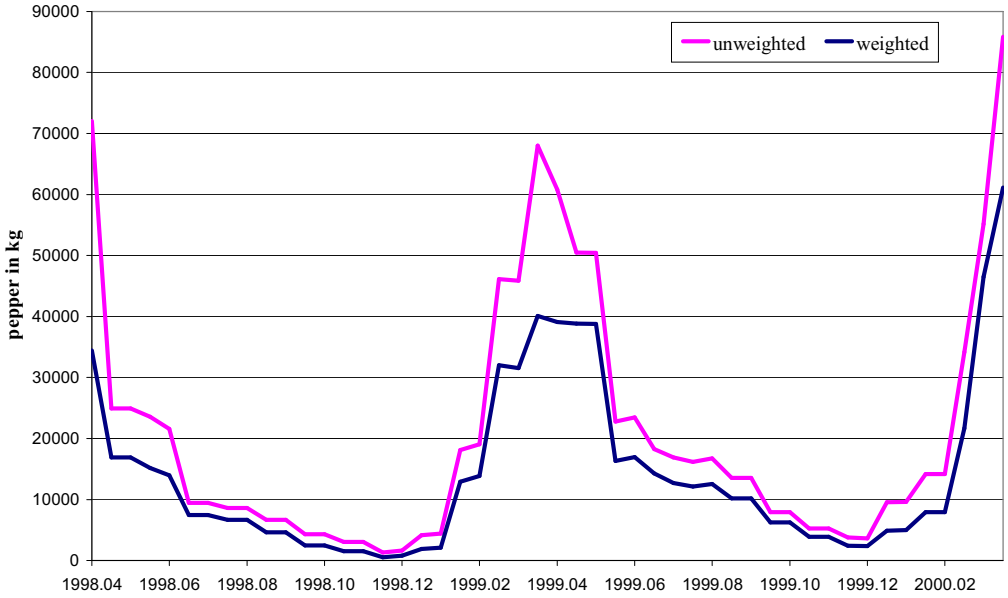
Storage of harvested output

In this section we focus on using stocks of harvested pepper as a store of value to be used in case of adverse income shocks. Storage of agricultural output requires commodities to be storable and non-perishable. These properties apply to pepper: pepper can be stored for considerable number of years without physical decay.[7]

Figure 6 shows the extent of storage of pepper over the season, among pepper growers. Each data point refers either to a start or an end of month stock level, aggregated over all households. The seasonal pattern of production is obvious from the figure. The figure also indicates a limited importance of carry over of pepper stocks from one season to another. Out of a total number of 250 growers, only 4 pepper growers in the season 1998-99 and 6 pepper growers in the season 1999-2000 recorded a positive stock of pepper in each month of the year.

[7] Some other crops which are grown by the farmers in our sample can be stored (e.g. natural rubber), but unfortunately we lack the data on stockholding of these commodities.

Figure 6 Stocks of pepper with pepper growers (microevidence)



Liquidation of assets

Households may also sell livestock in order to limit the adverse impact of negative income shocks. There is a large literature that investigates this hypothesis, with, however, diverging results (see e.g. Rozenzweig and Wolpin (1993); Lim and Townsend (1994); Fafchamps, Udry & Czukas (1996); Kinsey, Burger & Gunning (1998)).

A rigorous empirical test of whether and to what extent negative income shocks correspond with sales of livestock, cannot be implemented with our data set, since we lack data on revenues from selling livestock. It is possible that part of this revenue is one of the components of 'other income', as used in the section above on income diversification. In that case the risk reducing impact of selling livestock is incorporated in the impact of income diversification.

We do, however, have data on numbers of cattle, along with data on numbers of other assets, like household equipment, transport equipment and cultivation equipment. For the purpose of obtaining a measure of the importance of cattle raising we have aggregated bullocks, cows, calves and goats. Using this aggregation procedure, we are in the position to assess the quantitative importance of livestock for pepper growers. The following picture emerges if we look at the evidence:

- a substantial number of households – between 50% and 60% in the period 1998-2000 - do not raise livestock at all[8],
- the average number of cattle per household is low (around 3)[9], and
- there is no clear relationship between the number of livestock and holding size.

To our understanding liquidation of assets in the form of selling livestock as a mechanism to offset decreases in income may be important if farmers are to a considerable extent involved in cattle raising. Indian pepper growers often raise some livestock but raising cattle clearly appears to be a subsidiary activity.

Table 2

Changes in livestock

		number of households in % reporting a change				
		Bullocks	**Cows**	**Calves**	**Goats**	**Aggregated livestock**
1998-99	**Decrease**	1.6%	20.4%	10.0%	4.0%	21.6%
	No change	97.2%	74.4%	80.4%	91.2%	69.6%
	Increase	1.2%	5.2%	9.6%	4.8%	8.8%
1999-2000	**Decrease**	0.0%	0.0%	0.4%	0.4%	0.8%
	No change	100.0%	99.6%	98.8%	99.6%	98.4%
	Increase	0.0%	0.4%	0.8%	0.0%	0.8%

The hypothesis on the role of livestock particularly pertains to liquidation of assets in the case of income shortages. To get a feel of the number of changes in livestock that took place, we have shown changes in livestock by crop year in Table 2. Numbers in the table show a relatively higher decrease in livestock in the crop year 1998/99 relative to crop year 1999-2000. Crop revenue of pepper in both the crop year 1998/99 as well as 1999/2000 was relatively good, due to both high real prices and due to good yields in these years. Such favourable harvests and crop revenues are not the conditions in which one would expect farmers to liquidate assets in order to maintain acceptable levels of consumption. The decrease of livestock observed in

[8] This result is independent of the method of aggregation.

[9] The following figures may provide some perspective for the potential scope of using livestock sales to offset income shocks: average annual per capita total consumption expenditure is 9-10,000 rupees, average family size is 5 and estimated unit prices of livestock (cattle) varies between 5500 rupees (cows) and 1500-2000 rupees (calves, goats).

1998/99 and the lack of change in livestock observed in 1999/2000 are hard to reconcile with the favourable crop revenue in these years[10].

Financial savings and saving accounts

The evidence on the level of total income related to total consumption expenditure (see above) suggests that a considerable part of income is not used for current consumption expenditure. Apart from expenditure on investment it appears likely that substantial sums of money are (temporarily) set aside in some way or another, possibly in a relatively liquid form on bank or savings accounts. Unfortunately we do not have data on financial savings, and hence we are not in the position to verify this claim. We do have information on the use of bank accounts: it appears that around 75-85% of the farm households has a bank account. The data also indicate a slight increase in this share when the size of holding gets larger: around 70% of farmers with tiny holdings have a bank account, while more than 80% of farmers with holdings of 3 acres or larger have a bank account. From the reverse angle, also a substantial number of farmers (between 15-25%, and slightly higher among farmers with tiny holdings) do not make use of bank accounts, and hence have to rely on other methods for accumulating savings.

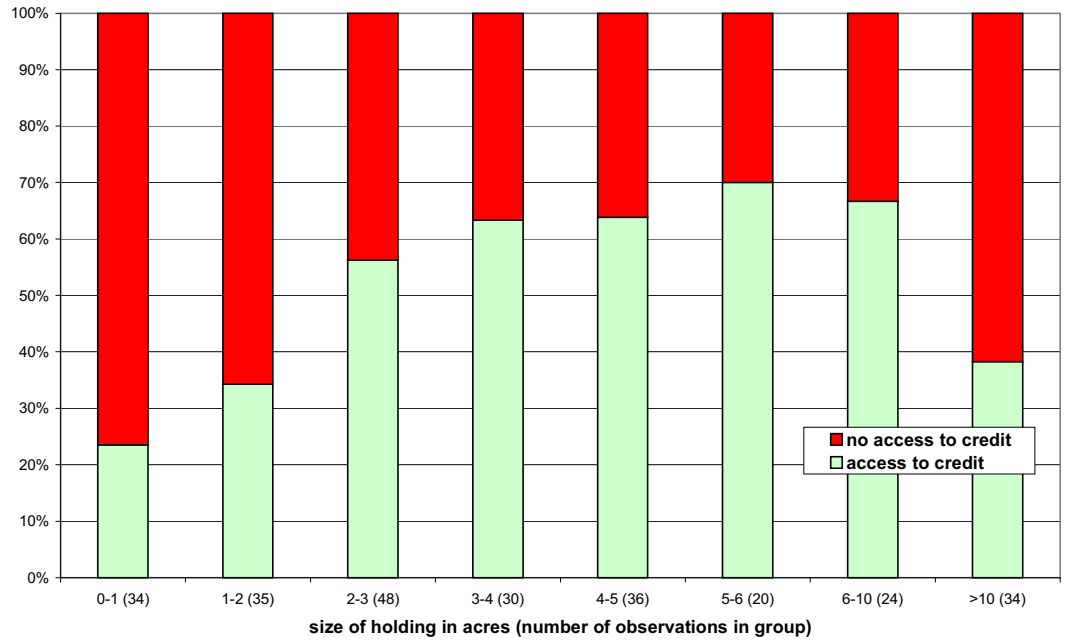
We may conclude that the use of bank accounts is widespread among pepper growers. It is most likely that these accounts are used for financial savings and play a major role in smoothing variations in current income. Though we do not have detailed information on the size and the use of financial savings we infer this from our other investigations: many growers appear to have excess income over consumption expenditure, few growers are making use of accumulation of non financial assets and, at the same time, growers have smoothed their consumption expenditure to a near to perfect extent (see below).

[10] Despite our contention that our data are not really suitable for testing the hypothesis of liquidation of non financial assets as a mechanism to cope with declining crop revenues, we have run a number of simple regressions. Declining crop revenues are identified by extracting those observations with a negative difference of annual crop revenue relative to average annual crop revenue. These observations are regressed on a constant and changes in livestock. We experimented with livestock specified by type of livestock as well as aggregated, and we also controlled for crop year. It should be noted that changes in livestock are only observed in numbers, and not in money values. We were, however, unable to identify a significant and positive relationship between these changes and negative income shocks. Though the presented evidence is far from conclusive, it is definitely not supportive to the hypothesis that livestock sales are – to any extent - used as a mechanism to offset negative income shocks.

3.4 Access to bank credit and formal insurance

The survey has recorded repayment of loans, payment of interest and new loans. We have identified households to have access to credit if, in any month during the survey period, repayment of loans or payments of interest have been made, or new loans have been taken. Once one of these transactions is recorded we identify this as revealed access to credit. Around 50% of all growers are identified to have revealed access to credit, which is, however, not evenly spread over households. Access to credit by size of holding, shown in Figure 7, suggests substantially lower access among growers with small holdings.

Figure 7 Revealed access to credit by size of holding



4. Measuring variation

4.1. Variation in crop revenue

The major concern to an individual farmer is the variation in his total income, and this is similar with the variation in crop revenue, if a large share of total income is derived from cultivation of a single crop. Since the farmers in our survey are primarily pepper growers, we continue with investigating variation of revenue from pepper. A number of conceptual issues need to be solved in the construction of the crop revenue data related to the price against which production is evaluated[11]. The result of the

[11] Actual revenues of pepper are recorded in the survey. However, since these sales are influenced by the storage behavior of the individual (see also below), variation in these sales are not particularly

calculation of variation in crop revenue, shown in Table 1, also report the breakdown of the CVs of crop revenue by holding size.

From Table 1 we observe a clear increase in the size of the risk if one controls for the number of vines. Risk appears to be lower if only 3 years of data are used. Inspection of the development of (real) prices suggest that this is most likely due to the smaller year to year variation in prices for this period. Differences in variation of crop revenue become substantial with larger sized holdings. If we focus on data from crop years 1997/98-99/00, the table suggests that the size of the revenue risk is larger for smaller sized farms than on medium and larger sized farms,

Table 3

Coefficient of variation of calculated crop revenue: Micro evidence

Holding size in acres	REVENUE		REVENUE PER VINE	
	1995/96-1999/00 5 crop years	1997/98-1999/00 3 crop years	1995/96-1999/00 5 crop years	1997/98-1999/00 3 crop years
0 – 2				
Average	52.4% (0.026)	48.3% (0.038)	54.2% (0.038)	49.3% (0.044)
Median	49.6% (0.015)	44.0% (0.039)	51.3% (0.021)	46.9% (0.027)
2 – 5				
Average	52.1% (0.020)	39.5% (0.022)	52.2% (0.029)	42.0% (0.028)
Median	49.6% (0.033)	34.7% (0.025)	50.5% (0.037)	42.7% (0.030)
> 5				
Average	60.6% (0.035)	40.7% (0.033)	61.2% (0.033)	45.3% (0.039)
Median	53.7% (0.019)	35.6% (0.033)	54.1% (0.026)	39.7% (0.049)
All growers				
Average	54.8% (0.017)	42.0% (0.016)	55.5% (0.019)	44.8% (0.024)
Median	50.8% (0.019)	38.2% (0.024)	52.2% (0.013)	41.6% (0.030)

Bootstrapped standard deviation in brackets next to the CVs; number of households: 61 (0-<2acres), 111 (2-<5 acres) and 78 (>=5 acres), 250 (all growers); State wise consumer price indices for agricultural labourers are used to convert revenue into constant prices; Source: Spices Board India, Cochin and ESI-VU, Amsterdam, The Netherlands.

representative of output risk. Hence, we have calculated potential revenues by multiplying the harvested quantity by the unit value realized by the individual farmer. In case no sales have been made in the entire season we have imputed the average unit value realized in the block. For the crop years 1995/96, 1996/97 and 1997/98, we lack data on per kg unit values of sales. We have solved this by using an appropriate fixed proportion of monthly market prices, taking account of the regional seasonal pattern in sales of farmers, available for the crop years 1998/99 and 1999/2000. This appears to be a reasonable assumption in view of the experience of the crop years 1998/99 and 1999/00 (see appendix).

4.2 Smoothing of consumption expenditure

To what extent does the variation in crop revenue have an impact on consumption? Consumption expenditure is recorded in the survey by asking pepper growers the market value of their last month consumption expenditures[12]. The survey data also allow a breakdown of total consumption expenditure in food items and non-food items. This is attractive since variation based on monthly data may be exaggerated due to purchases of consumer durables, and also since reduction of consumption expenditure on non-food items may function as a risk coping strategy. The coefficients of variation in the table are calculated on the basis of monthly data, but also on the basis
of annual data which are, in fact, aggregate of monthly data[13].

We have included variation in annual aggregates because:

- it makes variation in consumption expenditure comparable with variation in other variables: crop revenue and other income components are calculated on an annual basis.
- occasional outlays in consumer durables exaggerate the variation in consumtion expenditure if calculated on the basis of monthly data.
- by using annualised data we automatically control for seasonal variation.

The coefficients of variation of consumption expenditure, shown in Table 2, make clear that pepper growers are fairly successful in smoothing their consumption expenditure: If compared with the coefficient of variation of revenue, we observe a decrease from 55-59% in crop revenue to less than 15% in consumption expenditure.

[12] The question in the questionnaire on consumption is: "Could you give a breakdown of the last month money value of your consumption expenditure?". These "self reported" data on consumption expenditure contains a potential arbitrary element and is conceptually remote from the techniques applied in poverty assessments of the World Bank to estimate total household consumption (see e.g. Deaton (1992)). However, the consumption expenditure is reported on a monthly basis and since this reduces the 'recall' property of the reply, part of the arbitrariness is also limited.

[13] We have observations of consumption expenditure recorded at the end of each month, from April 1998 to August 2000, and hence 28 monthly observations per household. Annual series are constructed by summing to twelve month periods.

Table 4

Coefficient of variation of consumption expenditure : Micro evidence

Holding size in acres	Monthly observations	Annualised observations*
	Apr.1998-Aug.2000	1997/98-1999/2000
0 – 2		
Average	28.9% (0.036)	14.3% (0.014)
Median	18.7% (0.017)	11.4% (0.013)
2 – 5		
Average	27.0% (0.019)	13.6% (0.009)
Median	19.3% (0.011)	10.2% (0.010)
> 5		
Average	35.7% (0.020)	14.7% (0.011)
Median	30.9% (0.041)	12.6% (0.013)
All growers		
(Total consumption)	30.2% (0.016)	14.1% (0.006)
Average	21.2% (0.011)	11.2% (0.008)
Median		
All growers		
(Food consumption)	22.9% (0.006)	12.8% (0.006)
Average	21.3% (0.006)	10.8% (0.008)
Median		

Bootstrapped standard deviation in brackets next to the CVs; number of households: 61 (0-<2acres), 111 (2-<5 acres) and 78 (>=5 acres), 250 (all growers); State wise consumer price indices for agricultural labourers are used to convert consumption expenditure into constant prices; Source: Spices Board India, Cochin and ESI-VU, Amsterdam, The Netherlands.
* On the basis of monthly data on consumption expenditure from April 1998 to August 2000, we have constructed 3 annual consumption expenditure figures per household.

4.3 Smoothing of total income

The extent to which consumption smoothing is brought about by income smoothing may be evaluated by calculating the variation of total income. CVs of total income, shown in Table 3, make clear that variation in total income is lower than variation in crop revenue but only slightly. In combination with Table 1, we conclude that pepper growers with small holding sizes to some extent achieve a lower risk by income diversification. The coefficient of variation of crop revenue from pepper for this group of farmers is close to 50% (see Table 1, column 2 and 4) while it is around 25-

35% for total income. Assuming a unit coefficient of relative risk aversion, diversification of income sources has reduced costs of risk by more than 60% (from 12.5 % to 4.5%). Since the coefficient of variation of crop revenue from pepper of larger farmers (with a holding size larger than 5 acres) is around 40% (see also Table 1) less risk reduction is achieved with income diversification by this group.

Table 5

Coefficient of variation of total income: Micro evidence

	All pepper growers
Holding size in acres	
	1998/99-1999/2000
0 – 2	
Average	42.9% (0.038)
Median	34.2% (0.098)
2 – 5	
Average	34.7% (0.032)
Median	27.7% (0.034)
> 5	
Average	37.7% (0.032)
Median	28.9% (0.046)
All growers	
Average	37.5% (0.019)
Median	30.3% (0.029)

Bootstrapped standard deviation in brackets next to the CVs; number of households: 55 (0-<2acres), 106 (2-<5 acres) and 69 (>=5 acres), 230 all growers; State wise consumer price indices for agricultural labourers are used to convert total income into constant prices; Source: Spices Board India, Cochin and ESI-VU, Amsterdam, The Netherlands.

To complete the assessment of the extent of risk reduction through income diversification we have summarised the change in variation of pepper revenue to variation in total income, and the change from variation in total income to variation in total consumption expenditure. This combines the information of Table 1, 2 and 3. Both if calculated on the basis of averages and on the basis of medians the results of this exercise, reported in Table 4, suggest a moderate contribution to reduction of crop

revenue risk through income diversification. The table also clearly supports the earlier assertion that growers with median and smaller holding sizes have succeeded to some extent in reducing the cost of risk by income diversification. The cost of risk of growers with larger holding sizes (above 5 acres) is, on average, not reduced by income diversification.

Table 6

Change in variation: Micro evidence

Holding size in acres	from pepper revenue to total income	from total income to total consumption expenditure
0 – 2	-6.9 %-point	-28.3 %-point
Average	-2.3 %-point	-19.3 %-point
Median		
2 – 5	-7.0 %-point	-20.2 %-point
Average	-4.3 %-point	-13.1 %-point
Median		
> 5	0.0 %-point	-22.0 %-point
Average	0.0 %-point	-17.6 %-point
Median		
All growers		
Average	-4.9 %-point	-22.7 %-point
Median	-1.3 %-point	-15.6 %-point

Source: Spices Board India, Cochin and ESI-VU, Amsterdam, The Netherlands

A final qualification should be made on the extent of consumption smoothing achieved by income smoothing. Other authors (see Morduch (1995)) have argued that a high degree of income smoothing suggests that households have few other possibilities to deal with risk other than through such preventive measures. The reverse is also true: if only a small fraction of consumption smoothing is achieved by income smoothing, households apparently have access to other smoothing techniques. Although some income smoothing takes place (see Table 6), our empirical work suggests that the larger part of consumption smoothing is achieved by other methods.

5. Estimating consumption insurance

The lack of consumption insurance is defined by the degree to which the growth rate of household consumption covaries with the growth rate of total household income. In its extreme version complete insurance implies that changes in consumption are independent of idiosyncratic shocks affecting household income. Indeed, with the assumption of a complete market of state contingent claims, maximization of the intertemporal expected utility subject to an expected budget constraint, it follows that, after controlling for the influence of time varying taste factors, changes in consumption are only a function of covariate shocks and should not depend on household resources. This may be formalised as follows:

$$\Delta \ln(c_{ht}) = \sum_{lt} \alpha_{lt} DLOC_t + \gamma X_{ht} + \Delta \varepsilon_{ht}$$

where

$\Delta \ln(c_{ht})$ = change in the log of per capita consumption of household h in period t

DLOC = a set of dummy variables identifying locations

X_{ht} = vector of houshold(head) characteristics of household h in period t

α_{lt}, γ are parameters to be estimated, and $\Delta \varepsilon_{ht}$ is an error term

The set of location dummies interacted with time is intended to capture the role of covariate risk faced by households. Hence the α_{lt} 's are expected to be above zero. This theoretical assertion has motivated empirical researchers to investigate the following variant of the above equation:

$$\Delta \ln(c_{ht}) = \sum_{lt} \alpha_{lt} DLOC_t + \beta \Delta \ln(y_{ht}) + \gamma X_{ht} + \Delta \varepsilon_{ht}$$

where

$\Delta \ln(y_{ht})$ = change in the log of per capita income of household h in period t

$\alpha_{lt}, \beta, \gamma$ are parameters to be estimated, and $\Delta \varepsilon_{ht}$ is an error term

The parameter β provides an estimate of the extent to which idiosyncratic changes in household income play a role in explaining household specific rate of change of consumption. The rate of change of consumption under complete risk sharing will be independent of idiosyncratic shock and, hence, this is investigated by testing for $\beta = 0$. Likewise, and also practised in empirical work on consumption insurance, we may

interprete higher values of β as indicating a lower degree of consumption insurance or a higher degree of vulnerability to income risk.

A final refinement of the equation above concerns the instrumenting of the income variable (see Deaton (1997)). Since income is not exogenous, an auxiliary equation is used in which income is estimated as a function of shocks. On the basis of this estimation a variable is constructed which is used as explanatory variable in the consumption insurance equation. Since we lack data on shocks we cannot instrument the income variable. Consequently we assume that we estimate the above equation assuming negligible impact of not instrumenting the income variable.

Table 7

Estimating the degree of consumption insurance

Dependent variable: log(relative per capita real total consumption expenditure)		
Explanatory variables: log(relative per capita real total income) + dummies*		
	Specification of estimated equation:*	
	(1)	**(2)**
Size of holding	**Total consumption expenditure**	
0-<2	0.016 (0.5)	-0.016 (0.7)
2-<5	0.064 (2.6)	0.083 (3.3)
>=5	0.096 (2.2)	-0.037 (1.2)
All	0.053 (2.9)	0.014 (0.9)
Size of holding	**Consumption expenditure on food items**	
0-<2	-0.017 (0.9)	-0.042 (2.0)
2-<5	0.058 (2.4)	0.097 (4.1)
>=5	0.075 (2.2)	-0.014 (0.6)
All	0.034 (1.9)	0.017 (1.2)
Size of holding	**Consumption expenditure on non food**	
0-<2	0.054 (0.8)	0.018 (0.6)
2-<5	0.067 (1.6)	0.068 (1.8)
>=5	0.136 (1.9)	-0.044 (1.1)
All	0.079 (3.0)	0.018 (0.8)

* Dummies included:

(1) location (taluk) interacted with crop year ($DLOC_t$), and household characteristics (X_{ht})

(2) household characteristics (X_{ht})

All coefficients in the table refer to the income variable; Coefficients of dummy variables are not shown; Absolute t-values in brackets next to the coefficient; Number of observations: 110 (<2); 206 (2-<5); 150 (>=5); 466 (all); Huber-White sandwich estimator of variance is used to correct for hetero-scedasticity

Before discussing the estimation results a number of remarks should be made about measurement error. Both the income and consumption variable used in our estimations will suffer from measurement error (see appendix for construction of variables in the consumption insurance equation; see also footnote on conceptual issues of the income and consumption variable in Section 4). Measurement errors in both consumption and income may result in biased estimates. Measurement error in the income variable will give rise to attenuation bias, pushing coefficients down zero (see Deaton (1997)). In the case of positive coefficients on income which are statistically significant, one may safely conclude that the hypothesis of complete insurance should be rejected. If measurement error is serious, significant positive coefficients offer a lower bound of the lack of insurance. Measurement error in the consumption variable may, on the other hand, lead to an upward bias due to correlation of the measurement errors in consumption and income. It is difficult to determine to what extent this is the case in our data: measurement errors in consumption expenditure are usually due to the imputation of the value of consumption of home produced goods. Our consumption data do not make use of such an imputation, since they are obtained in a different way (though most likely not without measurement error!).

If we first consider the **estimation results for all growers**, we infer that there is lack of insurance to a moderate extent. The lack of insurance is smaller (less than half) in consumption expenditure of food than in consumption expenditure in consumption in non food. This suggests that non food consumption is to some extent used to buffer shocks and is also found elsewhere in the empirical literature (see Skoufias and Quisumbing (2003)). The difference between columns 1 and 2 establishes a measure of the idiosyncratic and covariant component of the lack of insurance: if estimated without location dummies, the coefficient of income should capture both covariant shocks and idiosyncratic shocks. Along this line of reasoning the 'all growers' estimation results in column 2 are hard to explain, since the coefficients are all insignificant (see also below, comments on estimation outcome by holding size).

The estimated values of the coefficients, the lack of complete insurance, compare well with other findings in the empirical literature. Other studies typically find values in the range from zero to 0.3, with a clear higher frequency of values of this parameter in the lower range (see e.g. Townsend (1994), Fafchamps and Lund (2003), Skoufias and Quisumbing (2003)).

If we consider the **estimation results by holding size**, the following picture emerges. Lack of consumption insurance increases with the size of holding. Growers with tiny holdings appear to be well insured: only growers with medium sized and large holdings show significant lack of insurance. Specifically growers with large sized holdings use non-food consumption expenditure to buffer income shocks: the coefficient is almost twice as high (and significant) on non food compared to food. As a matter of fact, it is only this group that accounts for this phenomenon in the 'all growers' estimates. The estimation results by holding size further indicate that the income risk for growers with medium sized holdings that gives rise to lack of consumption insurance (specifically food) should be attributed partly to idiosyncratic causes (estimations for these growers allow to interprete the coefficient of the second column as the sum of idiosyncratic and covariant risk in consumption).

6. Summary and conclusion

Income earned outside agriculture is identified as a coping mechanism, particularly among growers with tiny holdings. Financial savings most likely play an important role in consumption smoothing but this could only be supported indirectly. Little evidence is found for risk reduction through cutting back consumption, storage of commodities, diversification into alternative crops and sales of livestock.
Measurement of the variation of crop revenue, total income and consumption expenditure shows that pepper growers have smoothed total consumption expenditures considerably. Consumption smoothing by income smoothing occurs among growers with tiny and medium sized holdings but is of moderate size.
Although much consumption smoothing is shown to take place, pepper growers remain dependent income shocks and full insurance is not achieved. The estimations indicate a significant but small sized lack of insurance. However, growers with tiny holdings appear to be well insured: only growers with medium sized and large holdings show significant lack of insurance. Lack of consumption insurance increases with the size of holding. Using non-food consumption expenditure to buffer shocks is practised by growers with larger holding sizes.

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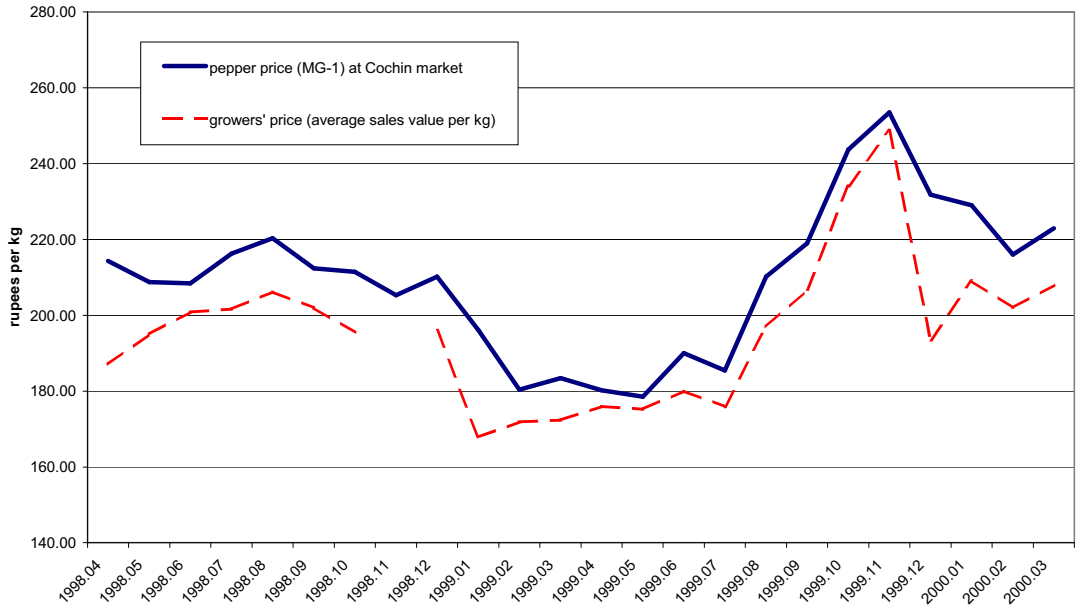
Apppendix

Table A1 Size of holdings and number of bearing vines

	Size of holding in acres										
Number of bearing vines	**<1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-7.5**	**7.5-10**	**10-15**	**15-50**	**>50**	
0-<=100	4.3%	3.0%	2.1%		0.4%	0.4%	0.4%				10.7%
100-<=200	3.0%	3.0%	1.7%	0.4%		1.7%	0.4%	1.3%			11.5%
200-<=300	3.0%	4.3%	1.3%	0.9%		0.4%	1.3%				11.1%
300-<=400	2.1%	2.6%	1.7%	1.7%	2.6%	1.3%	0.9%		0.4%		13.2%
400-<=500	1.3%	1.7%	2.1%	1.7%	0.9%	0.9%			0.4%		9.0%
500-<=600	1.3%	0.9%	2.1%	0.4%	0.9%	0.9%					6.4%
600-<=800	0.4%	2.1%	1.7%	2.6%	1.7%	1.3%		1.3%			11.1%
800-<=1000		2.6%	0.9%	1.7%	1.3%	0.9%	0.9%	0.4%			8.5%
1000-<=2000				4.3%	1.3%	0.9%	0.4%	1.7%	0.9%	0.4%	9.8%
>2000				0.4%	0.4%	0.4%	0.9%	0.9%	3.0%	2.6%	8.5%
	15.4%	20.1%	13.7%	14.1%	9.4%	9.0%	5.1%	5.6%	4.7%	3.0%	100%

Figure A2 Official market prices and growers' prices obtained from survey



Construction of income and consumption variables

In order to investigate the degree of consumption insurance we have estimated consumption on income, controlling for location variables (to account for covariant risk) and controlling for household characteristics (see Section 5 above). Consumption and income are per capita and in constant prices. We have used consumer price indices for agricultural labourers by state (Kerala, Karnataka and Tamil Nadu) to calculate consumption and income in constant prices. Both per capita real household consumption expenditure and total income are specified in the estimation as the natural logarithm of current per capita real household consumption expenditure and current per capita real household total income divided by their reference levels (hence: $\ln(c_{ht}/c_{h,reference})$ and $\ln(y_{ht}/y_{h,reference})$). We have complete data for two full crop years, namely the crop years 1998/1999 and 1999/2000 (we have more information outside these two crop years, but this is less complete, see below): this establishes the current values for per capita real household consumption expenditure and total income.

The reference level of consumption and income is obtained by calculating an arithmetic average of annual consumption and annual income. A third observation needed to calculate the average is constructed. Construction of data is only done for the calculation of the household reference variables. On consumption expenditure we have monthly data on total, food and non food consumption from April 1998 to August 2000. Three annual data are obtained by taking average monthly consumption expenditure from April 1998 to March 1999, from January 1999 to December 1999 and from September 1999 to August 2000, and inflating the averages to annual levels.

In order to calculate a reference value for household total income a different procedure is implemented. Total income is defined as the sum of crop revenue from pepper, other agricultural income and income outside agriculture. For the crop year 1997/1998 we do have crop revenue from pepper. On the basis of this information and on the basis of a variety of assumptions on the size of the remaining household income for 1997/1998 we have calculated total income. Amongst others we have assumed: no other income than revenues from pepper, other income proportional to average other income in the crop years 1998/1999 and 1999/2000, other income equal to average absolute other income in the crop years 1998/1999 and 1999/2000, and the maximum of the previous values. The estimation results are robust against the various ways we have calculated the reference value of total income.